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CONJOINT ANALYSIS OF GREEN CONSUMER PREFERENCES FOR ELECTRONIC PRODUCTS

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Abstract: *The paper deals with the environmentally friendly consumer behaviour and factors that influence green consumer purchasing. In order to explore the main determinants of green preferences for an electronic device, a choice-based conjoint analysis was applied, due to its power to force respondents to make a trade-off between conflicting attributes. Aggregated results suggest that technical performances are the most important features when purchasing electronic equipment, while environmental characteristics, price and warranty period are rather important, but not crucial. In order to detect subgroups of respondents characterized by heterogeneous preferences that can remain latent in aggregated results, preference-based clustering was performed using k-means procedure. As a result, four clusters were identified, one of which was the subgroup of environmentally aware respondents. Finally, a market simulation was conducted to assess the willingness of consumers to pay for the upgrading of both technical and ecological product features.*

Keywords: *Green purchase behaviour; Choice-based conjoint analysis; Preferences; Utility; MWTP*

1. Introduction

Environmental concerns have increased significantly over the last three decades, making the concept of sustainability a trend. The market has responded to increasing consumer environmental awareness by developing 'environmentally friendly' products and promoting the environmentally responsible consumption, the so called green consumption. It addresses the purchase of products with minimal adverse impact on the ecosystem and society.

Green consumption is a controversial term because green refers to the conservation of natural resources, while consumption usually causes their destruction. Unlike the conventional consumption culture, which is egocentric and anti-collective, green consumption is part of a broader repertoire of political and collective behavior, lifestyle, civic and ethical attitudes (Peattie, 2010).

Raising eco-consciousness has created a growing segment of environmentally responsible consumers and accordingly, many companies have incorporated the principle of sustainability into their business strategies. Accordingly, academic research in this field focuses on identifying motivational factors and explaining the economic, social, and psychological aspects that influence environmentally conscious behavior (Kaufmann et al., 2012; Kim & Choi, 2005). In spite of ongoing efforts, it is still difficult to anticipate the adoption of green consumer practices. In fact, consumers' real behaviour often differs from expressed attitudes, as purchasing decisions are predominantly

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based on the estimation of benefits and costs. Moreover, it is unlikely that ecological responsibility brings immediate personal gain or satisfaction, but effects that are oriented towards the future.

This paper deals with the measuring of green consumers' preferences when purchasing electronic equipment. The abundance of electronic products on the market, rapid technological development and continuous launch of new models encourage consumers to buy newer, better and more modern devices. On the other hand, a significant erosion of quality and durability has emerged. In order to be price competitive, manufacturers reduce product quality and often intentionally embed delayed software errors. The phenomenon of planned obsolescence is dramatically enhanced. After two, three years warranty expires, as well as manufacturer's responsibility. Spare parts are hardly available or too expensive, so the repair is no longer worth. The defective device has become obsolete while new models are already in stores. Manufacturers create demand for new equipments, but consequently an enormous electronic waste as well. Therefore, consumers' awareness of green product's characteristics and recycling possibilities are very important.

The purpose of this research is to empirically explore the green preferences towards an electronic device such as portable mobile phone charger, also known as power bank, to determine whether the preferences are heterogeneous, and to examine their impact on purchasing decisions. The research method applied for this purpose is the choice-based conjoint analysis, the widely used technique in the field of new product and service development, as well as in exploring consumers' preferences towards environmentally friendly products such as green vehicles (Eggers & Eggers, 2011; Olson, 2013; Stöckigt et al., 2018; Hille et al., 2017), and willingness to pay eco-labelled products (Hidrue et al., 2011; Costa et al., 2019; Hinnen et al., 2017).

The rest of paper is structured as follows: Section 2 describes the concepts of environmentally conscious behaviour and provides a detailed overview of factors influencing green purchasing. Methodology of choice-based conjoint analysis and the study design for determining consumers' green preferences towards the power bank are given in Section 3. Section 4 is focused on explainig empirical results. Finally, the main conclusions are summarized in Section 5.

2. Literature review

2.1. Environmentally friendly behaviour

Environmental concern is the degree to which an individual is aware of environmental issues, recognizes the need to address them, and is willing to take part in their solution (Álvarez-González et al., 2015). Accordingly, environmentally friendly purchasing is a form of ethical and socially responsible behaviour, where consumers consider the general consequences of their private consumption and try to exploit their purchasing power so as not to endanger the environment (Joshi & Rahman, 2015). Eco-friendly purchasing can also be viewed as an act of sacrificing some of the benefits and performances while increasing costs, and as such, it can not be explained only by the theory of rational choice. Actually, it is also motivated by attitudes, values, social norms and many other psychological factors.

Green consumerism involves various activities such as recycling, resource and energy saving, community cleanliness and environmental legislation (Coleman et al., 2011). The duration of product usage is also significant, so "slow consumption" appears as a new topic of research (Peattie, 2010).

According to Akehurst et al. (2012), the green consumer is "an individual who acts, purchases and consumes in accordance with the need for environmental preservation, refusing to use products that are harmful to the environment". Costa Pinto et al. (2014)

note that the green consumer behaves so to "purchase and use products with lower environmental impacts, such as biodegradable products, recycled or reduced packaging, and low energy usage".

Green consumers can be roughly classified into two categories (Carfagna et al., 2014): (1) Buy-cotters – consumers who buy green products when they have the ability to choose, and (2) Boycotters – consumers who consciously and deliberately refuse to buy non-green products. Autio et al. (2009) recognize the three key roles adopted by young consumers: anti-hero, ecological hero, and anarchist. An ecological hero fosters positive aspects of green consumption, while antihero rejects both the idea of green consumption and the individual's ability to make a difference. For an anarchist, green consumption is a reaction against the dominant consumer culture (Peattie, 2010). According to Johnstone and Tan (2014) some people avoid eco-friendly behaviour, believing that they retain self-identity and are not subject to manipulation.

Finally, the question arises as to whether it is better to buy environmentally friendly products or reduce consumption. The focus of most researches and environmental policy makers is on the first option, because it does not jeopardize economic growth, while the second would lead to decline in economic activity, which is unfavourable to state strategy of any country.

2.2. Factors affecting pro-environmental behaviour

Consumer decisions on the purchase of green products and services are strongly affected by various factors. Based on the literature review, Joshi and Rahman (2015) identified the dominant motives that influence buying decisions of green products and grouped them into either individual or situational ones. However, mainly all all factors can be grouped in four categories: psychological, social, socio-demographic and those related to product attributes.

Numerous empirical evidences support the positive correlation between environmental attitudes and pro-environmental behaviours (Paço & Lavrador, 2017; Sudbury-Riley & Kohlbacher, 2015). Among the other psychological factors that influence pro-environmental behavior, the most researched are: environmental knowledge (Aman et al., 2012), perceived consumer effectiveness (Kim & Choi, 2005), altruism (Kaufmann et al., 2012), risk (Schubert & Chai, 2012), and emotions such as guilty consciousness (Kabadayı et al., 2015).

Most purchasing behaviours reflect social relations and obligations related to cultural and social values. Norms, as a form of social values, influence behaviour by encouraging an individual to behave ecologically, in order to gain approval and acceptance of the social community, build a social identity and meet the needs of inclusion and self-affirmation (Nye & Hargreaves, 2010; Peattie, 2010). The media play a key role in building a modern consumer culture and by sharing environmental information it triggers public awareness (Peattie, 2010).

It was already proven that product attributes and consumers' knowledge about product attributes strongly affect their purchase behaviour. Consumers generally prefer functional attributes over ethical characteristics and are not willing to sacrifice product performance in favour of green characteristics. However, the perception that the green product is of high quality, positively influences ecological purchasing, especially regarding organic food and cosmetics (Joshi & Rahman, 2015). The competitiveness of green products can be enhanced by other characteristics such as convenience or durability, and in many cases the attractiveness of the packaging or even the place where they are exposed (Collins, 2014). Technical performance turned out as the most important decision making factor relating to electronic equipment (Mudgal, et al., 2012), but energy efficiency, as a green component, has also proven to be a strong motivator, due to long-term savings.

Consumers' confidence in green brands also encourages green purchasing, so eco-labels are very important. However, green labels on vendors' own brands are not always credible, because their criteria are rarely verifiable. The international survey conducted in 2007 demonstrated that only 10% of respondents believed in information provided by companies (Euroactiv, 2016), so that the labels approved by independent third-parties ensure this kind of trust.

Price is often the main factor that affects buying behaviour (Collins, 2014) and green preferences are usually expressed through willingness to pay premium price for green products (Joshi & Rahman, 2015). According to Nielsen’s global survey, slightly more than 50% of respondents check the labels before purchasing, and are willing to pay more for products made by environmentally responsible companies (Nielsen, 2014). Surveyed electricity customers in Germany expressed willingness to pay 16% premium price for electricity from renewable sources (Kaenzig & Heinzle, 2013). High prices of green products are the most common barriers to eco-purchasing and increase inconsistency between environmental attitudes and behaviour. However, customers are ready to pay a higher price for green product that offer economic benefits in the long term, like electric cars or home appliances (Lai et al., 2015). In many developing countries, green buying is a relatively new concept at an early stage of development, and only competitive pricing strategies can attract prospective green customers (Datta, 2011).

Attempts of demographic segmentation of green consumers are often unsuccessful and give contradictory results, which is especially noticeable in the case of gender (Akehurst et al., 2012; Carfagna, et al., 2014) and age. Some research found that young consumers are more sensitive to environmental issues and have higher levels of environmental concern than older people, but most studies provide opposite results (Roman et al., 2015; Isaacs, 2015). The generation of young consumers, the so-called Generation Y or Millennials, is known to be the most consumption-oriented generation ever. They hold a very positive attitude towards sustainability due to public education received early in life. Nevertheless, Salaün & Pontet (2013) found that for Millennials, green attitudes are not predictors of behaviour, nor have significant influence on their purchase decisions. This generation is driven mainly by its own interests and is willing to buy green products only if they are more energy efficient, better, cheaper or healthier (Salaün & Pontet, 2013).

According to some studies, the income is positively correlated with pro-environmental behaviour (Kaufmann et al., 2012; Roman et al., 2015), wile some other studies deny it (Carfagna et al., 2014). According to Álvarez-González et al. (2015), persons with a higher or university education and the political ideology of left or center-left, related to the sense of social justice and respect for nature, and are more likely to accept ethical or green consumption as a civic action or a strategy for social change

3. An empirical study of preferences towards green power bank

The basic assumptions of this study are that the preferences of the respondents are heterogeneous as indicated in the literature, and are influenced by various factors. The question arises as to which extent the respondents value the green characteristics of the product when purchasing, and whether there is a segment that attaches great importance to the eco-dimension of the product.

3.1. Choice-based conjoint analysis

To determine green customers' preferences in this study, the research technique known as conjoint analysis was used. This is one of the most commonly used tools that helps in discovering what people really value in products and services, and on what basis they make decisions about buying and using them (Popović et al., 2020). Conjoint measurement originates from psychometry and behavioural theory and represents a tool for analyzing the psychological process of narrowing the choices in order to discover true or hidden motivators, sometimes unclear to the respondents themselves.

Conjoint analysis is a decomposition method that implies the breaking down a product or service into its characteristics (attributes), and subsequently studying the cumulative effect of attributes on consumer preferences (Kuzmanovic et al., 2013). The name of the method stems from the fact that the attributes are *con*sider *joint*ly. Attributes are specified by their levels - quantitative or qualitative measures of attributes, and the product is perceived as a unique set of different attribute levels. Consumers evaluate the overall utility of the product by combining individual partial utilities that reflect desirability of specific attribute levels. The true value of conjoint analysis is its ability to force respondents to make a trade-off between conflicting attributes and to determine how willing they are to give up one for some other attribute.

A type of conjoint analysis that is often used in practice is Choice-Based Conjoint analysis - CBC. Instead of simply asking respondents what product characteristics are most important to them, CBC uses a more realistic tasks where respondents are expected to choose between multiple product concepts (Kuzmanovic & Makajić-Nikolić, 2020). For example, instead of direct questions like "Which of the following features is most important to you when buying a portable phone charger?" or "Would you be willing to pay some more money for ecological features?", respondents are asked to choose one of three different product alternatives (concepts), forcing them to express their preferences in real market situations.

The consumer preference model in CBC relies on random utility theory, describing the utility that respondent i ($i = 1, \dots, I$) assigns to concept j ($j = 1, \dots, J$) in a choice set s ($s = 1, \dots, S$) as the sum of deterministic and random components (Kessels et al., 2011):

$$U_{ijs} = \boldsymbol{x}'_{ijs}\beta + \varepsilon_{ijs}$$

In the deterministic component, $\boldsymbol{x}'_{ijs}$ is a vector indicating what levels are covered by the concept *j* of the choice set *s* for respondent *i*. The vector elements can take values of 0 or 1 depending on whether a particular level of an attribute is contained or not in the concept *j*. The β is a vector of parameters that represent the effects of the attribute levels on the utility. The random component ε_{ijs} is the error term, which is assumed to be independent and identically distributed. The probability that respondent *I* chooses concept *j* in choice set *s* can be expressed as:

$$P_{ijs} = \frac{e^{x'_{ijs}\beta}}{\sum_{t=1}^{J} e^{x'_{its}\beta}}.$$

Hierarchical Bayes (HB) estimation was used to estimate the model parameters. Amongst other benefits, HB allows more parameters to be estimated with less data collected from each subject and estimates of parameters for each subject individually.

The estimated parameters β, known as part-worth utilities, represent the quantitative preference degrees for each level of the attribute. The larger these values, the greater the preference for the specific attribute level. Using these utilities, the preferences strength for each attribute (relative importance) could also be determined. The relative importance of an attribute is the ratio of the utility range for that attribute and the sum of the utility ranges for all attributes, expressed as a percentage (Kuzmanović et al., 2019).

3.2. Study design

There are several stages in CBC. The first and the most crucial stage involves identifying the attributes relevant to the stated research questions and then assigning levels for each of these attributes. Typically, the levels should reflect the spectrum of performances that respondents can expect to experience and the levels of one attribute must vary independently of the levels of other attributes. Ensuring the levels are realistic and meaningful will increase the accuracy of parameter estimation.

Following these principles, in addition to the price attribute, four other key attributes are selected (Table 1). Charging power is the three-level attribute related to the technical characteristics of the product. Two attributes are attached to the sustainability (power supply and housing material) and one is associated with the after-sale support (warranty period). But as previously noted, the warranty period often indicates the quality and durability of the product and therefore indirectly impacts environment.

The number of considered attributes and their levels result in a total of 162 (=$3^4 \times 2$) possible product concepts that could be constructed, which further reflects on too many possible choices tasks. However, it is unrealistic to impose such a large number of tasks to respondents, so that we used fractional factorial design, meaning that a subset of all possible profiles was offered.

Table 1. List of attributes and attribute levels considered in the survey

Attributes	Level 1	Level 2	Level 3
Power supply	electrical energy	solar energy	electrical & solar energy
Housing material	non-degradable plastics	biodegradable plastics	
Price	10€	15€	20€
Capacity (charging power)	2 hours	4 hours	6 hours
Warranty period	6 months	12 months	24months

An efficient experimental design that ensures minimal overlap of product concepts was created using the *Conjoint.ly* online platform. A total of two blocks of 12 tasks were generated, each containing three product concepts. For each concept, an image of a product with the appropriate type of power supply was shown, so that respondents can more easily imagine the products they are comparing (see Figure 1).

Figure 1. Example of a choice task in CBC

To determine the sample size required for reliable study results, the rule of thumb as proposed by Orme (2010) was used. According to this rule, the minimum sample size is conditioned by the number of choice tasks (c), the number *of* alternatives per task (a), and the largest product of levels of any two attributes (p), i.e. $N > 500p/(c \times a)$. Thus, minimum sample size for this study was 110.

Along with the choice tasks, respondents were asked to answer to a short questionary about their socio-demographic profile. A five-point Likert scale was used for self-assessment of environmental responsibility. Participants rated the degree of agreement with statements about their willingness to pay a slightly higher price for a green electronic device, frequency of participation in ecological actions, waste disposal and their own commitment to ecology. Additionally, the Constant Sum Questions required respondents to distribute a total of 100 points across four group of product characteristics, according to the perceived importance.

4. Results

4.1. Sample characteristics

Data were collected using *Conjoint.ly* online platform. A total of 1,550 individuals approached the survey, but only 187 fully completed the questionnaires. In addition, 28 low quality responses were excluded from the further processing due to inconsistency or too short response time (less than 3 minutes), giving a total of 159 valid responses. Median length of interview was 7.1 minutes.

Demographic structure is presented in Table 2. The vast majority were young respondents (76% under 25 years old), reflecting preferences of the growing consumer group. Gender structure was slightly uneven, with 66% of women. Economic status was rather poor, encompassing 56% respondents with monthly income below 340€, in line with Serbian average.

Asked to evaluate their awareness and habits regarding environmental issues on the scale from 1 to 5, respondents rated themselves as moderately environmentally aware (average score of 3.3), fairly oriented to green purchasing (average score of 3.3), but do not often participate in ecological actions (average score of 2.7).

When allocating the total of 100 points to the product characteristics by their relevance, technical performances appeared as the most important, with a mean weight of 40/100 points, followed by a price (32/100 points). Despite the previously declared environmental concern, "ecological" characteristics took the last place with a mean weight of only 13/100 points.

However, these are average results of the entire sample. Table 3 provides more detailed insight of data related to certain subgroups, pointing to the differences in terms of their attitudes and behaviour. Thus, ecologically conscious respondents are more likely to participate in ecological actions and are more willing to buy green electronic devices at a higher price. They value much more the ecological product characteristics than those who have declared themselves less environmentally conscientious (19 versus 9), while for the latter, prices and technical characteristics have a higher priority.

Table 2: Demographic data

Variable	Category	Percentage (%)
Gender	Male	34
	Female	66
Age	< 25	76
	25-40	9
	> 40	16
Level of education	Elementary sch.	0.63
	High school	52.2
	Undergraduate	39
	Master degree	6.2
	PhD degree	1.89
Employment status	Student	67
	Unemployed	4
	Employed	29
Averaged monthly income per household member*	up to 20,000	16
	21,000-40,000	40
	41,000-60,000	16
	61,000-80,000	13
	more than 80,000	15

* in rsd (120 rsd = 1€)

When it comes to gender, women are more likely to participate in ecological actions and are more willing to buy electronic devices at a higher price than men. Nevertheless, both men and women evaluate themselves equally ecologically responsible though in both segments, the ecological dimension is the least important factor of purchasing decisions. On the other hand, men are slightly more focused on technical characteristics than women. As far as the age, respondents aged over 25 show much higher environmental awareness and behaviour, put emphasis on green characteristics but also on warranty period than the younger ones.

Table 3. Attitudes and perceived relevance of dimensions

	All responses	Ecologically responsible	Ecologically irresponsible	Male	Female	up to 25	over 25
Attitudes							
I consider myself to be ecologically responsible	3.26	4.39	2.49	3.26	3.26	3.15	3.59
I buy green electronics if the price is not much higher	3.34	3.78	3.04	3.00	3.51	3.23	3.69
I participate in ecological actions	2.69	3.16	2.37	2.35	2.86	2.58	3.03
Dimensions							
Price	32	29	34	32	33	33	31
Technical performances	40	36	42	43	38	41	34
Environmental characteristics	13	19	9	11	14	12	18
Warranty period	15	16	15	14	15	14	17

4.2. Respondents' preferences

Using HB approach, utility parameters were estimated separately for each respondent, enabling the calculation of both overall and subgroup preferences. Part-worths provide a deeper insight into levels within the attributes that determine the consumer's choice. The more positive part-worth is, the level is more attractive. The utilities are scaled so that the sum of all part-worths is equal to zero within each attribute individually.

Figure 2 presents the estimated part-worths and indicates that certain levels are more desirable than the others for the whole sample as well as for subgroups. For example, a 6-hour rechargeable battery is highly desirable for all subjects, while a 2-hour rechargeable capacity is highly undesirable. Furthermore, biodegradable plastic is a highly acceptable housing material - an environmental feature that could therefore mean a shorter lifespan due to a weaker structure. The same goes for power supply - all subgroups favour the equipment with both electrical and solar charging modes. Finally, it can be concluded that the optimal levels that most stimulate the consumer's choice are: electrical and solar power supply, bio-degradable plastics, lowest price (10€), 6 hours charging capacity, and 24 months warranty period.

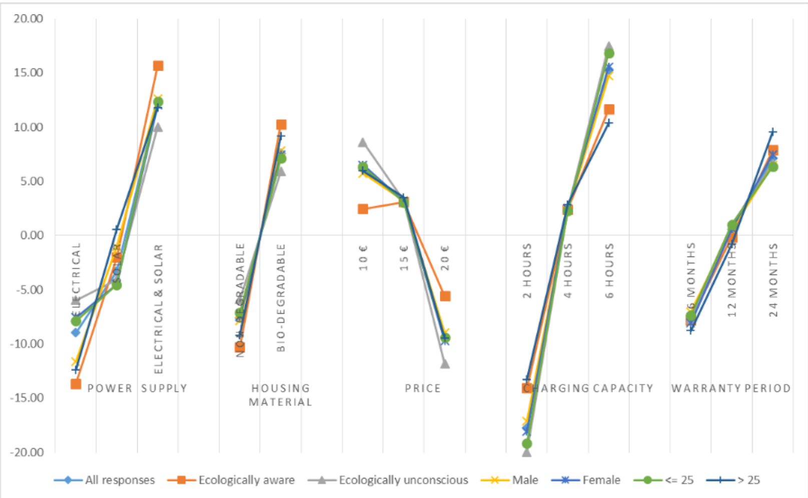

Figure 2. Part-worths for sample at whole and across the subgroups

While the part-worths reflect the desirability of a certain attribute level, they do not point out the relative importance of the attribute compared to others. The attribute utility range is considered as a measure of its influence, so that a large range indicates that variations have a significant impact on the concept's overall utility. The relative importance of an attribute for variation in preferences is obtained by dividing its own range with the sum of all attributes' ranges. In other words, the significance of each attribute is the sum of absolute values of its part-worths and it reflects its relative importance in regard to other attributes.

Table 4 indicates that the charging capacity, followed by power supply mode, are the most influential attributes that form the respondents' preferences, with a relative importances of 33% and 21.2% respectively. Housing material, price and warranty have almost equal pertinence of about 15% each. The results confirm the previously declared relevance of technical performances obtained by constant sum method. However, the significance of the price of 32% seems to be overestimated by constant sum method, because Conjoint analysis revealed much less importance of price (15.7%) and proves that in fact respondents are ready to sacrifice some more money for better product performances and even to green product features.

Table 4. Relative attribute importance for sample at whole and across the subgroups

Attribute	All responses	Ecologically responsible	Ecologically irresponsible	Male	Female	up to 25	over 25
Power supply	21.2	29.3	16.0	24.3	19.6	20.2	24.2
Housing material	15.2	20.6	11.8	15.7	15.0	14.2	18.4
Price	15.7	8.7	20.4	14.7	16.2	15.8	15.5
Charging capacity	33.0	25.7	37.5	31.8	33.7	36.0	23.6
Warranty period	14.8	15.7	14.3	13.5	15.6	13.7	18.3

Concerning subgroups' affinities, the respondents who perceive themselves as environmentally responsible attach much more importance to ecological characteristics (20.6%) than other subgroups. Even for them, technical features continue to be key decision-making factor with relative importance above 25% (charging capacity 25.7% and power supply 29.3%). Their commitment to ecology is expressed by low relevance of the price (only 8.7%) and willingness to devote money to the environmental purposes.

4.3. Preference based clustering

The overall results of choice-based conjoint analysis represent mean values of consumer preferences at the entire sample level. Preference based clustering allows the finer granulation within the whole sample and the detection of subgroups with similar preferences which remain latent in overall result. For the purpose of preference-based clustering, we applied k-means cluster analysis.

Using the Calinian-Harabasz criterion and the Dunn index, four clusters are isolated: performance-oriented cluster, cluster with balanced preferences, environmentally aware cluster, and price sensitive cluster. Their size has turned out to be well-balanced, with 23%, 32%, 25% and 20% of respondents. Relative importance of attributes across the clusters are presented in Figure 3.

Cluster 1 - Performance-oriented

The performance-oriented segment contains 23% of the total number of respondents. With a relative value of 51%, the capacity of a power bank is by far the most important attribute that influences the purchase decision (Figure 3). Charging mode, as the second technical feature, is notably less decisive (16%), while other characteristics take just a little over 10% significance.

Figure 3. Relative importance of attributes across post hoc defined clusters

Part-worths imply that strong technical performances, such as 6 hours charging power and the capability of both electrical and solar supply modes, are highly appreciated. Respondents expressed the aversion to low charging capacity, high price, and a short warranty period (Figure 4).

When directly asked about the attribute importance, members of this cluster stated the price more significant (30/100 points) than conjoint analysis revealed (12%). This confirms the value of the conjoint analysis that requires respondents to make a trade-off between attributes, giving more realistic estimation of preferences than the direct assessment can allow.

This cluster is made up of students and employees of a better material status who often use portable batteries. The high price does not discourage them remarkably because they are focused on technological aspects and can afford the more performing devices.

Figure 4. Part-worths for performance-oriented cluster

In reference to the self-assessment of the environmental responsibility and the readiness to pay the premium price for a green product, the average grade of about 3.2 indicates the conformity with the medium values for the entire sample. Nevertheless, members of this cluster are not fairly involved in environmental activities (2.57).

Cluster 2 - Balanced

The second cluster (Balanced) is the largest one, containing 32% of the total sample. The members of this cluster carefully evaluate all the attributes and try to find a compromise. The results obtained by constant sum method suggest that technical performance and price are leading by priority, while other dimensions are far behind. Conjoint analysis gives quite different results: all attributes except green characteristics have similar importance, with the latter being less crucial. This is the segment that cares most about the warranty period. Also, the price is taken with caution and costly products are quite undesirable. Only in this cluster the part-worth values show an extremely high tolerance of poor capacity as a result of trade-off between other features (Figure 5).

A stronger focus on price and warranty overrides the importance of technical performances and inevitably require willingness to accept low charging capacity. Biodegradable housing material is favoured over the opposite one, but, as previously mentioned, green properties are not essential.

The cluster does not differ in certain demographic characteristics, and habits and attitudes are in line with the sample average.

Cluster 3 – Environmentally aware

The third cluster includes 25% of respondents with more noticeable green preferences compared to other clusters. The relative importance of green characteristics is 27% according to the conjoint analysis and 24% according to the constant sum approach, which are fairly consistent values. For the members of this segment, the price is an almost insignificant factor (only 5%), although in the direct evaluation the price was allocated a higher weight (28/100 points).

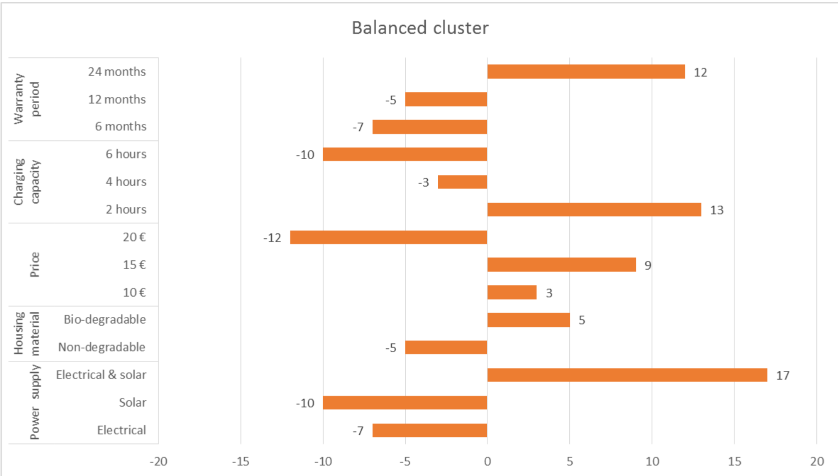

Figure 5. Part-worths for balanced cluster

Parth-worths point out the emphasis on green aspects – rejection of non-degradable materials and solely electrical power supply (Figure 6). Like the previous one, neither this cluster is distinguished by some specific demographic characteristics, while habits and attitudes are in line with the sample average. The results of self-assessment are in line with the sample average, with environmentally awareness of 3.28, green purchasing orientation of 3.32, and not frequent participation in ecological actions (2.7).

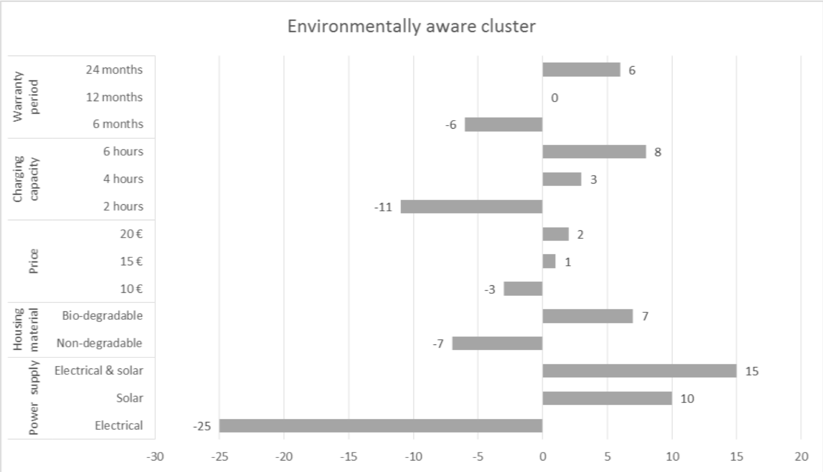

Figure 6. Part-worths for environmentally aware cluster

Cluster 4 – Price sensitive

The fourth cluster encompasses 20% of the total number of respondents and consists of people focused on direct and immediate benefits: price and technical performances, which is expressed through direct assessment and proven by conjoint analysis results. These respondents show little interest in ecology – a relative importance of 4% in the conjoint analysis and 8/100 points awarded in direct ranking. Part-worth utilities shown on Figure 7 confirm an aversion to high prices and low charging capacity.

This cluster is also not distinguished by some specific demographic characteristic, and all self-assessment scores are in line with the sample average.

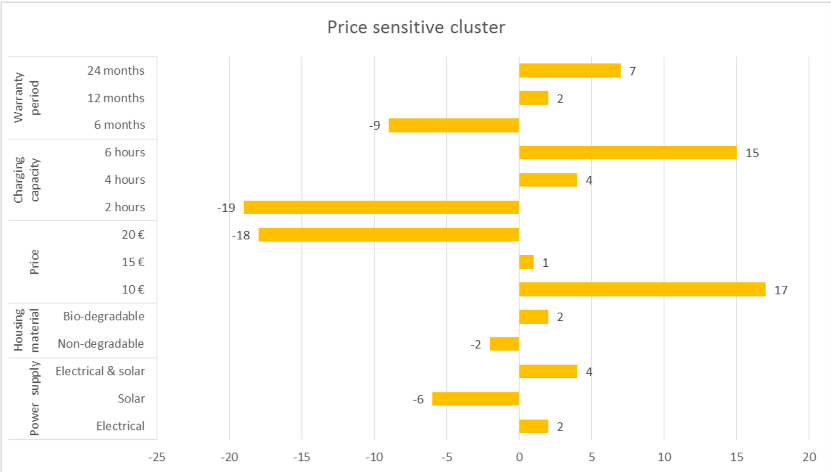

Figure 7. Part-worths for price sensitive aware cluster

4.4. Marginal willingness to pay

In order to determine the amount of money that respondents are ready to pay for an upgrade a particular product feature, a marginal-willingness-to-pay (MWTP) was estimated. MWTP is always relative to a baseline product with reference characteristics for whose improvement the readiness to pay is estimated. It can be assessed using the respondent-level part-worths calculated by HB:

$$MWTP_{ik} = \frac{\Delta P}{\Delta \beta_{i,price}} \times \Delta \beta_{ik}$$

where ΔP is a range in price levels, $\Delta \beta_{i,price}$ is the range in part-worth utilities that i-th respondent attached to the price attribute, $\Delta \beta_{ik}$ is a range in utility attributable to attribute k for respondent i (obtained by subtracting the utility of the baseline level from the utility of the considered level of an attribute k). This should be done for all levels of all attributes for all respondents. Then, MWTP can be determined as a median of respondents' WTPs for all attribute levels. Let us assume that the baseline product costs 10€ and has the following features: only electrical power supply mode, housing made of non-degradable plastics, capacity of 2 hours of charging, and a warranty period of 6 months. Figure 8 shows MWTP for all attribute levels considered in this study.

MWTP for upgrading housing material to be of biodegradable plastic is 6.66€. However, the largest amount that consumers would be willing to allocate is the one for upgrading the capacity. Figure 8 shows that customers are ready to pay 8.84€ for upgrading the capacity to 4 hours of charging and even 14.45€ for 6 hours of charging. Since the Conjoint analysis finds the capacity as the most important attribute, it was expected that customers would most appreciate this type of upgrade.

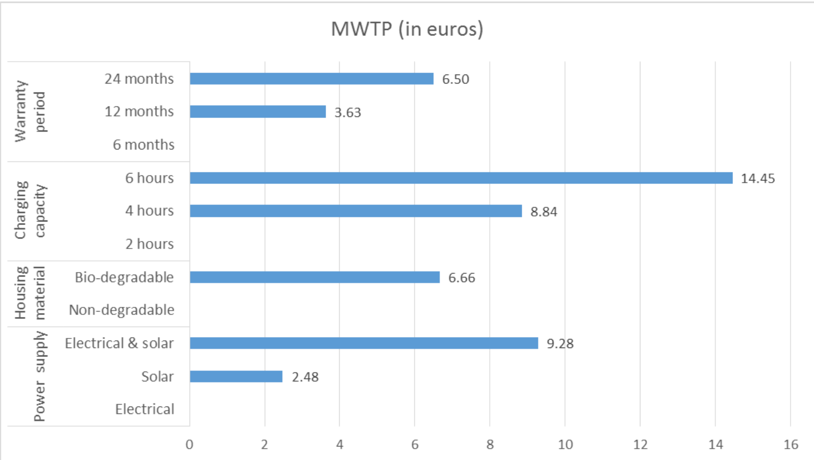

Figure 8. MWTP for upgrading to certain attribute level

In addition, customers are willing to pay as much as 9.28€ to upgrade the power supply mode from purely electric to both electric and solar mode, due to previously expressed aversion to single power source. MWTP for extending the warranty period to 12 months is 3.63€, and 6.5€ to 24 months, as shown on Figure 8. Although the warranty period was not very significant feature compared to others, those amounts are quite high.

5. Conclusions

The prevailing opinion of the modern economy is that the current level of consumption is unsustainable, as it leads to the depletion of resources and global pollution. The assumption of consumer sovereignty is no longer adequate because of the societal interest in channeling a preference for less and green consumption. The findings of numerous empirical studies indicate that the main drivers of green purchasing are environmental awareness, collectivism, altruism, guilt aversion, subjective norms and legislation, while high prices, habits and skepticism of personal importance are seen as major obstacles.

Conjoint analysis of ecological preferences presented in this paper has shown a positive impact of green product features, but technical performances and price as more significant product attributes in case of electronic equipment purchase behavior. Findings confirm the results of most studies about the dominant importance of technical performances in the case of electronic equipment purchase, which is expected because they form the essence of such products. Although the price is widely proven as a common barrier to green behavior, its significance seems to be overestimated, since respondents are generally ready to devote their money to better product performances and even to green characteristics. While the performance-oriented consumer segment is distinguished by slightly higher income levels, socio-demographic profile of environmentally responsible consumers practically does not exist. The findings of this study confirm that environmental preferences and attitudes are largely personal in nature and that individual psychological variables are also important in explaining green consumption behavior, which is in line with some other studies (Kim & Choi, 2005; Akehurst et al., 2012).

The theoretical significance of this study is that it adds to the existing body of knowledge the findings on the relative importance of green attributes that influence purchasing intentions of consumers. On the other hand, the practical significance is reflected in the fact that the study results can provide valuable information to companies to help them design favorable products for consumers more efficiently, while respecting sustainability and social responsibility.

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